Challenges and New Solutions for Enhancing Ancillary Services and Grid Resiliency in Low Inertia Power Systems

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The growth in converter-interfaced generation (CIG) and the use of renewable energy sources has led to a decrease in system inertia, frequency control, system strength, and voltage stability. This has created new challenges for power system operators to ensure power quality, system stability, security, flexibility and resiliency.

These challenges can be solved through resiliency, which involves the incorporation of stability and security constraints in markets, other ancillary services and control mechanisms as well as faster and smarter regulation design, more flexible operation, new ancillary market mechanisms, and appropriate planning decisions.

This special issue focuses on challenges and solutions of developing enhanced ancillary services, grid resiliency and other control mechanisms in low-inertia power systems. In this context, contributions related to the following ancillary services (Energy balancing, Margin, Voltage and Whole System) are expected: Frequency responses, Reserves, Voltage controls, Reactive power services, Improvement of power quality, and Demand responses. Prospective authors are invited to submit their original regular and survey papers in these areas, sharing the corresponding industrial and/or academic experiences with our readers.

Topics covered include but are not limited to:

- **Advanced Control Models** including: methodologies to equip onshore/offshore wind energy conversion systems, photovoltaic parks, energy storage systems and dynamic loads with new frequency/voltage control capability to improve power grid resilience; design of synthetic inertia and applications of virtual synchronous machines; new methods for monitoring regional inertia; revisiting the control and protection strategies at the device and system level; analytical, computational and data-driven methodologies for determining minimum system strength; control mechanisms for dynamic reactive power support to enhance fault ride through; flexible wide-area monitoring and control systems; and digital technologies supporting Advanced Control Methods

- **Optimal System Operation** including: optimal time/ramp-up/ramp-down approach to hand-over fast frequency response/governors; resilience-oriented coordination of fast frequency response, primary, secondary and tertiary reserves; optimal allocation of inertia and damping coefficient of converter-based generations; and technologies supporting Optimal System Operation

- **Market Mechanisms and Planning** including: design of a new market mechanism for fast response reserve; ancillary service markets considering voltage, generator angle, rate-of-change-of-frequency, frequency nadir and quasi-steady-state frequency deviation constraints; stochastic scheduling and planning with fast frequency response/voltage control requirements; and technologies supporting Market Mechanisms and Planning

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